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TRACK: TECHNICAL TOPIC: Advanced resource modelling

FROM TRADES TO TURBINES ? RECENT DEVELOPMENTS AND APPLICATIONS OF THE NUMERICAL WIND ATLAS METHODOLOGY

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The wind atlas methodology combines measurements, microscale modelling and mesoscale modelling to obtain a verified and reliable wind atlas for a region of any size. As such, it offers new opportunities for wind farm planning on a large scale, even with limited availability of wind data from meteorological stations. At prospective wind farm sites it provides a consistent basis for verification of model results against each other and against measurements and the methodology may be applied with a view to reducing uncertainties and risks. In this presentation we will discuss the range of methods and give examples of recent applications.

Risø DTU has been involved in wind resource estimation for many years. Initially, we used observed winds and microscale modelling within the WAsP (the Wind Atlas Analysis and Application Program) software. This method has proven very accurate in places such as Denmark where the landscape is relatively flat, the wind climatology is mainly driven by synoptic-scale weather patterns, and where a dense observational network is available.

For regions with a sparse observation network or with more complex terrain, large-scale geostrophic winds derived from global reanalysis are brought down to the mesoscale by using a statistical-dynamical downscaling method. The method uses a classification of the large-scale wind patterns which is then adjusted to the higher resolutions by the use of idealized mesoscale model simulations. Once mesoscale-corrected winds classes are calculated, they are linked to microscale models to take into account the true characteristics of the landscape. In both methods the common goal is to create generalized wind climates, from which location-specific wind climates can be calculated.

The generalized (or regional) wind climate gives the frequency distributions of wind speed and direction for standardized and idealized terrain conditions. It serves to link mesoscale to microscale and vice-verse. Without this link, it is not possible to make a proper verification of wind climates derived from modelling against measured winds or apply the mesoscale results for wind farm studies.

The results of the statistical-dynamical approach are not as accurate in regions where topographically forced and thermally induced effects dominate the boundary layer wind climatology. For this reason, we are currently developing enhancements to the system by exploring the use of stronger dynamical components to the statistical-dynamical method including comparison to a purely dynamical downscaling simulation for the area of interest. In this presentation we will discuss the range of methods and give examples of recent applications to wind atlas generation.

The wind atlas methodology combines measurements, microscale modelling and mesoscale modelling to obtain a verified and reliable wind atlas for a region of any size. It offers new opportunities for wind farm planning on a large scale, even with limited availability of wind data from meteorological stations. At prospective wind farm sites, it provides a consistent basis for verification of model results against each other and against measurements and the methodology may be applied with a view to reducing uncertainties and risks.